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NOTE

Observations of Extrafloral Nectar Feeding by Predaceous and Fungivorous Mites

The value of predaceous mites as agents for reducing the populations of plant-feeding mites is significant (McMurtry et al. 1970. Hilgardia 42: 331–390). Many plants have evolved ways to attract and maintain these important predators. Leaves of some plants being attacked by spider mites release volatile chemicals to attract predatory mites and help them locate prey (Dicke and Sabelis. 1988. Netherlands Journal of Zoology 38: 148–165). Other plants employ leaf domatia as a means of enhancing the presence and abundance of predaceous mites and fungivorous mites. Leaf domatia are hair tufts, pits or pockets located at the leaf vein junctions of many plants that act as shelters and nursery sites for these beneficial mites (Pemberton and Turner. 1989. American Journal of Botany 76: 105–112; O'Dowd and Willson. 1989. Biological Journal of the Linnean Society 37: 191–236). Leaves bearing leaf domatia have been found to have more predaceous mites than leaves that do not have leaf domatia (Walter and O'Dowd. 1992. Environmental Entomology 21: 478–484).

Extrafloral nectaries are sugar secreting glands (found primarily on leaves) which have been shown by many studies to promote a food for protection mutualism between plants and ants (Beattie. 1985. The Evolutionary Ecology of Ant-Plant Mutualisms. Cambridge University Press, Cambridge). This note is the first report of extrafloral nectar feeding by predaceous and fungivorous mites.

On July 27, 1990, three red-colored mites of the genus *Anystis* (Anystidae) were observed to feed on the extrafloral nectaries of *Prunus sargentii* Rehder growing in Seoul, South Korea. The nectaries involved were on the leaf petioles of sucker growth at the tree base. Two mites ran rapidly over the surfaces of several leaves, then stopped at the extrafloral nectaries to feed. The third mite was feeding at a gland when first noticed and, after about ten seconds of feeding, it also began to run. Later in the season (October 23), two other *Anystis* mites were seen feeding at the extrafloral nectaries on the petiole-blade junctions on some young leaves of sapling *Populus tomentiglandulosa* T. Lee, also growing in Seoul. These mites behaved in a similar manner to those observed on *P. sargentii,* running rapidly over the leaf surfaces, stopping for a period of feeding, and then running again. The time spent feeding is estimated to have been 15 seconds or less at each gland. Usually only one of the large, paired glands was fed upon. The observations were facilitated by the large size (2–3 mm) and red color of these mites, and the prominently placed, large nectaries of the poplar and cherry. Since the mites were immature and not identifiable to species, it is unknown whether they belong to one or more *Anystis* species.

On August 10, 1990, while observing extrafloral nectaries on a *Paulownia tomentosa* (Thunb.) Steud. (Scrophulariaceae) leaf (from a tree growing in Seoul), under the dissecting microscope, I noticed many *Czenspinskia sp.* (Oud.) (Winterschmidtiidae) feeding at the glands. The extrafloral nectaries of *P. tomentosa* leaves are tiny spherical cups, about 1 mm in diameter, located along and upon the bases of the veins on the upper surface and between the major vein junctions on the lower surface. The nectar feeding mites stood on their hind legs on the leaf surface adjacent to the gland and leaned against the lip of the rim of the gland with their forelegs, enabling their heads and mouth parts to reach the nectar within the

cup. The mites fed either alone or in groups of up to four individuals at a single gland. This feeding was observed only at the nectaries located on the bottom surface of the leaf. A total of about 20 mites were observed engaged in this nectar feeding during an hour's observation. During this time the mites moved between glands, walking up and over empty glands and stopping to feed at the glands with nectar.

On September 9, 1992, I observed a *P. tomentosa* leaf which had many *Czenspinskia* walking around and on top of empty nectaries. From an adjacent tree I found a leaf with many actively secreting nectaries but no *Czenspinskia*. I placed the undersides of these two leaves together, set them on a lab bench and pressed them together with a heavy book. After one hour, I examined the leaf with active nectaries and noted that large numbers of the *Czenspinskia* had transferred to this leaf and were feeding at many of the nectaries. Most of the mites were feeding at the glands, frequently in groups of three to five per gland.

The value of extrafloral nectar to these mites is probably primarily as an energy source, but it could have additional nutritional value since most extrafloral nectars contain many amino acids (Baker et al. 1978. Botanical Gazette 139: 322–332). Since most extrafloral nectaries function on young growth and usually cease secretion after leaves reach their full size and harden, the availability of extrafloral nectar to the mites would be mainly in the spring. The extrafloral nectaries of *P. tomentosa* are an exception to this generality because they often continue to function in older leaves. Plants growing under irrigation or in areas with rainy summers, such as Korea, have enough moisture for new growth of foliage in the summer and autumn, making the period of nectar availability much longer (Pemberton. 1990. Korean Journal of Ecology 13: 251–266). Extrafloral nectar is probably particularly valuable during the absence of prey and may serve to maintain these predatory and fungus eating mites on the plants or in the habitat until prey becomes available.

In addition to ants, many other predaceous and parasitic arthropods are frequent visitors to extrafloral nectaries, including parasitic Hymenoptera (Hespenheide. 1985. Ecological Entomology 10: 191–204) and coccinellid beetles (Pemberton and Vandenburg. 1993. Proceedings of the Entomological Society of Washington 95: 131–151). These insects might also cause reductions in the insect herbivores attacking plants that bear the glands. Research is needed to determine the frequency of extrafloral nectar feeding by beneficial mites, and what its significance may be for both the mites and the plants. Extrafloral nectar feeding by predaceous mites could prove to be of considerable importance in pest management. Many economic plants, such as cotton and stonefruits (*Prunus* spp.), bear extrafloral nectaries, and predaceous mites are increasingly important biological control agents.

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